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Patent claims

1. A method for mounting a flap (3) on a workpiece (1), in particular on a vehicle body (1), wherein the flap (3) is positioned precisely with respect to a reference area (11, 30) on the workpiece (1),

- which method uses a gripping tool (5) which is guided by means of a robot (7) and which comprises a securing device (14) for holding the flap (3) and a sensor system (18) which is permanently connected to the gripping tool (5) and has at least one sensor (19),
- wherein the gripping tool (5) is firstly moved, within the scope of a positioning phase (A-2), from a proximity position (37), which is independent of the position of the workpiece (1) in the working space (27) of the robot (7), into a mounting position (29) in which the flap (3) which is held in the gripping tool (5) is oriented in a precisely positioned fashion with respect to the reference area (11, 30) of the workpiece (1),
- and wherein the flap (3) is connected to the workpiece (1) in this mounting position (29) of the gripping tool (5), characterized in that, in order to move into the mounting position (29), an iterative closed-loop control process is run through, in the course of which
- an (actual) measured value of the at least one sensor (19) is generated,
- this (actual) measured value is compared with a (setpoint) measured value which is generated within the scope of a setup phase,
- a movement vector of the gripping tool (5) is calculated from the difference between the (actual) measured value and the (setpoint) measured value using a Jacobi matrix calculated within the scope of the setup phase,
- the gripping tool (5) is moved by an amount equal to this movement vector.

2. The method as claimed in claim 1, characterized in that the iterative closed-loop control process is aborted if

- either the deviation between the (setpoint) measured value and (actual) measured value lies below a predetermined threshold value, or

- the reduction, brought about in successive iteration steps, in this deviation lies below a predefined threshold.

3. The method as claimed in claim 1 or 2, characterized
- in that, after the closed-loop controlled movement into the mounting position (29), the gripping tool (5) is moved into an avoidance position (38) in a open-loop controlled fashion,
- in that attachment elements (9) are attached to the workpiece (1) using a robot-controlled hinge mounting system (6),
- in that the gripping tool (5) is moved back into the mounting position (29) in an open-loop controlled fashion from the avoidance position, and
- in that the flap (3) which is held in the gripping tool (5) is attached to the attachment elements (9).

4. The method as claimed in claim 3, characterized in that, in order to attach the attachment elements (9) to the workpiece (1),
- the hinge mounting system (6) is firstly moved under the control of a robot into a proximity position (48) which is independent of the position of the workpiece (1) in the working space (27) of the robot (8),
- the hinge mounting system (6) is then moved in an iterative closed-loop control process into a working position (41) in which the hinge mounting system (6) is oriented in a precisely positioned fashion with respect to the gripping tool (5),
- and a processing operation (C-2) is then carried out under the control of a robot, in the course of which operation (C-2) the attachment elements (9) which are fed in the hinge mounting system (6) are connected to the workpiece (1).

5. The method as claimed in one of claims 1 to 4, characterized in that the attachment elements (9) are hinges which are screwed to the workpiece (1) and to the flap (3).

6. The method as claimed in one of the preceding claims, characterized in that a TCP/IP interface is used for communicating between the open-loop control system (10) of the robot (7, 8) and the evaluation unit (33, 45) of the sensor system (18, 24).

7. The use of the method as claimed in one of claims 1 to 6, characterized in that the method is used for mounting a vehicle door (3) on a vehicle body (1).

8. A device for mounting a flap (3) on a workpiece (1) in particular for mounting a vehicle door on a vehicle body,

- having a gripping tool (5) which is guided by means of a robot (7),
- having a sensor system (18) which is permanently connected to the gripping tool (5) and comprises at least one sensor (19),
- having an open-loop control system (10) for open-loop controlling the robot (7) and the gripping tool (5),
- and having an evaluation unit (33) for evaluating the measured values of the sensor system (18), characterized in that at least one of the sensors (19) is a metrically non calibrated sensor.

9. The device as claimed in claim 8, characterized in that the at least one sensor (19) is an optical gap measuring sensor.